Corrosion-resistant current collector with mfg. method

Stainless Steel

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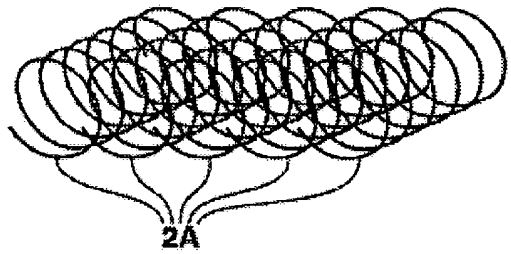
Abstract of **DE19517443**

A procedure for making a corrosion-resistant current collector with a high grade steel carrier and a nickel coating has the seamless nickel-plated wire (3) bent into a three dimensional structure to form the collector. The wire is wound into a spiral and the structure is then formed by spirals stacked beside each other. A variant has the wire intertwined to form a 3-D mesh. The mesh is then bent into a rectangular, triangular or sawtooth shape. The wire diameter is between 0.1 and 0.6mm, but preferably between 0.25 and 0.35mm. The proportion of nickel to steel is between 5% and 50% but preferably between 15% and 35%.



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In English:

The invention concerns a current collector corrosion resistant with a substrate made of high-grade steel and an anti-corrosive coating from nickel, as well as a procedure for the production of such. In particular the invention concerns a such current collector corrosion resistant for use in more carburizing (more reducing) atmosphere at high temperatures, in particular for the use as current collector in the anode region of a fusion carbonate gas cell, as well as again a procedure for the production of such. In the anode region to a fusion carbonate gas cell conditions - carburizing atmosphere and low oxygen partial pressure as well as presence of lithium and potassium carbonate melts - prevail which to a rapid corrosion of high-grade steel components contained in the fusion carbonate gas cells lead. This corrosion substantially accelerated by the high temperatures, which prevail with the enterprise of fusion carbonate gas cells. The cause for this corrosion is that in the carburizing atmosphere formed the oxide coatings, contrary to such, are which are formed in an oxidizing atmosphere not close and stable and therefore protect-protecting those does not forbid itself the used highly alloyed high-grade steel in carburizing atmosphere often selected use of aluminum-bearing steel or the Aluminieren of the steel for the energized parts, thus in particular the current collectors in the anode region, used in fusion carbonate gas cells, because of the very high electrical resistance of the developing oxide coatings. A further problem insists in creeping the melted salts electrolytes on such metallic construction units. This creeping is one of the loss mechanisms electrolytes and works limiting on the life span of the gas cell. In addition creeping favours the contamination of a fission gas reaction catalyst with that, planned for the enterprise of the fusion carbonate gas cells, electrolytes and not possibly makes thereby the employment of a direct internal reformation, which is to be regarded energetically seen as particularly favourable.

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Die Erfindung betrifft einen
korrosionsbeständigen Stromkollektor mit einem
Trägermaterial aus Edelstahl und einer
Korrosionsschutzbeschichtung aus Nickel, sowie
ein Verfahren zur Herstellung eines solchen.
Insbesondere betrifft die Erfindung einen
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In English:

In principle both the corrosion and creeping of the melted electrolyte salts on the metallic construction units in the anode region can be prevented by fusion carbonate gas cells by a coating of the high-grade steel sheet metals with nickel. Because nickel is inert in the atmosphere contained in the anode region and by the melt is not moistened. Coating the construction units with nickel happens with flat components e.g. with plating and with three-dimensional parts with galvanic coating or with applying a TiN Ni layer by means of thin-film technology. The problem is too own to the procedure by galvanic coating or by coating by means of thin-film technology, used with three-dimensional parts that the layers cannot be applied evenly. Both techniques work to a certain extent in "in the sight" procedure, D h.Flaechen, which lies in the right angle for coating direction or at different distance, receive different layer thicknesses. Even if a certain given minimum coating strength is to be achieved in the places with the smallest growth rate of the coating, then inevitably a repeated of the necessary minimum coating strength results in the places with larger growth rate of the coating. Thus an unnecessary consumption of nickel is connected and coating thus uneconomic. This applies in particular to galvanic nickel plating of the current collectors, for which sulfur-poor Sulfamatnickel necessarily be in particular with larger construction units - the surface desired for a gas cell about a square meter amounts to order-of-magnitude-wise - the adherence to close tolerances is with in applying thick galvanic nickel layers very difficult. Applying of the coatings by means of thin-film technology is very expensive with the necessary coating thicknesses from more largely 0.5 mu m to 1.0 mu m. Further satisfyingly the problem not solved so far yet exists with applying nickel layers by means of thin-film technology that still no sufficiently firm adhesion can be managed by Ni on TiN. Also still the task of the distribution of the gaseous fuel over the anode comes to the current collectors used in the anode region of fusion carbonate gas cells apart from the switching of the electrical contact. This reached by three-dimensional structuring of the current collector. Thus at current collectors to the use in gas cells, in particular in fusion carbonate gas cells the following demands are made: - the current collectors must form springy, spherical electrical edge contacts against the electrode and against the bipolar plate; - the current collectors must exhibit a sufficiently high electrical conductivity; - the current collectors must be steady against the steel melt electrolytes; - the current collectors must exhibit a polished, nonporous nickel surface at least on that the anode turned side as creep barrier; - the mechanical stability must be sufficient at the temperatures of 650 DEG C, dominant in the gas cell, and the there available pressure; and - the current collectors must be producible to low costs.

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Prinzipiell können sowohl die Korrosion als
auch das Kriechen der geschmolzenen
Elektrolytsalze auf den metallischen Bauteilen
im Anodenraum von
Schmelzkarbonatbrennstoffzellen durch eine
Beschichtung der Edelstahlbleche mit Nickel
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In English:

The task of the invention is it, a current collector corrosion resistant of the kind mentioned of indicating in particular for applications in more carburizing (more reducing) atmosphere at high temperatures and a procedure for the production of such with which with a small need of nickel a sufficient corrosion resistance is reached. This task is solved in accordance with the available invention by the fact that the current collector is formed for plated high-grade steel wire by a three-dimensional structure out smoothly with nickel. An advantage according to invention manufactured of the current collector consists of the fact that the mechanical and electrical characteristics can be varied by the choice of the strength and the feather/spring characteristics of the high-grade steel wire as well as by the kind of its processing within a wide range and be adapted to the respective requirements. In the following one remark examples of the invention are described on the basis the design. Show: Fig. 1 in increased yardstick an opinion of a plane of section one with nickel plated high-grade steel wire, how it is used with the available invention; Fig. 2a and 2b in the perspective opinion and in the side view schematize the three-dimensional structure of a first remark example of a current collector according to invention; Fig. the three-dimensional structure of a second remark example of a current collector according to invention schematizes 3 in the plan view; Fig. 4a, 4b and 4c in the perspective opinion schematize the three-dimensional structures of three remark examples of a current collector according to invention. Fig. 1 shows around the yardstick the 260: 1 increased opinion of the cut by a nickel-plated high-grade steel wire 3, how it is used with the available invention for the production of the three-dimensional structure of the current collector. The high-grade steel wire 3 covers a core made of high-grade steel 3A, which is surrounded by a nickel coat 3B. The diameter of the wire amounts to between 0,1 and 0,6 millimeters, preferably between 0,25 to 0.35 millimeters. The upper border of 0,6 millimeters was selected for economic reasons, it applies however by no means limiting, with certain applications can also a still larger wire size be used. The portion of nickel for the quantity of the steel in the wire is appropriate for smaller wire size between 5 and 50%, preferably between 15 and 35%. Bei increases the portion of nickel opposite the steel, while it becomes smaller with larger wire sizes. The nickel coat 3B surrounds the core 3A of the wire smoothly, whereby the minimum thickness of the coating nowhere should be fallen below. This is to be guaranteed by the selected plating procedure. With the first remark example of the three-dimensional structure of the current collector shown in Fig. 2a in perspective opinion are a number of spiral springs 2A in line. Everyone of these spiral springs 2A is wound from the nickel-plated high-grade steel wire 3. The side view of the structure is to be seen in Fig. 2b.

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Die Aufgabe der Erfindung ist es, einen
korrosionsbeständigen Stromkollektor der
genannten Art, insbesondere für Anwendungen in
aufkohlender (reduzierender) Atmosphäre bei
hohen Temperaturen und ein Verfahren zur
Herstellung eines solchen anzugeben, bei denen
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In English:

With in Fig. 3 second remark example shown of the three-dimensional structure of the current collector are into one another devoured a number of meshes 2B of the nickel-plated high-grade steel wire 3. With the remark examples of the three-dimensional structure shown in Fig. 4a, 4b and 4c the nickel-plated high-grade steel wire was manufactured to a wire mesh verwoben and the three-dimensional structure by Plissieren and/or training folds. With the third remark example shown in Fig. 4a the wire mesh is in such a way plissiert that the three-dimensional structure is rechteckfoermig 1C in the cross section, whereby the raised ranges of the three-dimensional structure exhibit the same surface as the sunk ranges. With the fourth remark example of the three-dimensional structure shown in Fig. 4b 1D the wire mesh is likewise plissiert in the cross section rechteckfoermig, however the raised ranges have a larger surface than the sunk range with the fifth remark example of the three-dimensional structure 1E shown in Fig. 4c are in such a way plissiert finally the wire mesh that a dreieckfoermiger cross section results. Very different mechanical and electrical characteristics of the current collector can be achieved by the different shaping of the wire mesh, i.e. different contact areas and kiss pressures both on the side to the electrode as well as on that the bipolar plate of the gas cell turned side. Apart from the execution forms shown the three-dimensional structure can be formed naturally also in other way by devouring, weaving and Ineinanderwinden of the nickel-plated high-grade steel wire. A current collector corrosion resistant is created by the available invention, which exhibits in more carburizing (more reducing) atmosphere at high temperatures.an-excellent-corrosion.resistance and for the use as current collector in the anode region is suitable of fusion carbonate gas cells thus in particular. ----------

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Bei dem in Fig. 3 gezeigten zweiten Ausführungsbeispiel der dreidimensionalen Struktur des Stromkollektors sind eine Anzahl von Maschen 2B des nickelplattierten Edelstahldrahts 3 ineinander verschlungen.

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In English:

1. Procedure for the production of a current collector corrosion resistant marked by a substrate made of high-grade steel and an anti-corrosive coating from nickel, by the fact that smoothly with nickel plated high-grade steel wire (3) into a three-dimensional structure (1A; 1B; 1C; 1D; 1E is brought) and the current collector by the three-dimensional structure is formed. 2. Procedure for the production of a current collector corrosion resistant according to requirement 1, by the fact characterized that the nickel-plated high-grade steel wire (3) is wound to spiral springs (2A) and the three-dimensional structure (1A) is formed by lining up the spiral springs (2A). 3.Verfahren for the production of a current collector corrosion resistant according to requirement 1, by the fact characterized that the three-dimensional structure (1B) is formed by devouring meshes (2B) of the nickel-plated high-grade steel wire (3) to a three-dimensional fabric. 4. Procedure for the production of a current collector corrosion resistant according to requirement 1, by the fact characterized that the nickel-plated high-grade steel wire to a wire mesh verwoben and the wire mesh by Plissieren into a three-dimensional structure (1C; 1D; 1E is brought). 5. Procedure for the production of a current collector corrosion resistant according to requirement 4, by the fact characterized that the plissierte wire mesh is in the cross section rectangle -, triangle or like saw teeth. 6.Verfahren for the production of a current collector corrosion resistant after one of the requirements 1 to 5, by the fact characterized that the diameter of the nickel-plated high-grade steel wire (3) 0.1 to 0.6 millimeters, preferably 0.25 to 0.35 millimeters amounts to. 7. Procedure for the production of a current collector corrosion resistant after one the requirement 1 to 6, by the fact characterized that the portion of nickel amounts to related to the quantity of the steel 5 to 50%, preferably 15 to 35%. 8. Current collector corrosion resistant marked by a substrate made of high-grade steel and an anti-corrosive coating from nickel, by the fact that the current collector by a three-dimensional structure (1A; 1B; 1C; 1D; 1E) is out smoothly with nickel plated high-grade steel wire (3) formed. 9.Korrosionsbestaendiger current collector according to requirement 8, by the fact characterized that the three-dimensional structure (1A) is formed by spiral springs in line (2A) from the nickel-plated high-grade steel wire (3). 10. Current collector corrosion resistant according to requirement 8, by the fact characterized that the three-dimensional structure (1B) is formed by a three-dimensional fabric from meshes (2B) of the nickel-plated high-grade steel wire (3). 11 Current collector corrosion resistant according to requirement 8, by the fact characterized that the three-dimensional structure (1C; 1D; 1E) by a plissiertes wire mesh is formed. 12. Current collector corrosion resistant according to requirement 11, by the fact characterized that the plissierte wire mesh is in the cross section rectangle -, triangle or like saw teeth. 13. Current collector corrosion resistant after one of the requirements 8 to 12, by the fact characterized that the diameter of the nickel-plated wire (3) 0.1 to 0.6 millimeters, preferably 0.25 to 0.35 millimeters amounts to. 14. Current collector corrosion resistant after one of the requirements 8 to 13, by the fact characterized that the portion of nickel amounts to related to the quantity of the steel 5 to 50%, preferably 15 to 35%. 15. Current collector corrosion resistant after one of the requirements 8 to 14, characterized by the use in more carburizing (more reducing) atmosphere at high temperatures. 16. Current collector corrosion resistant after one of the requirements 8 to 15, characterized by the use as current collector in the anode region of a fusion carbonate gas cell. ----------

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